UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Alaska Fisheries Science Center
Resource Assessment and Conservation Engineering Division
7600 Sand Point Way Northeast
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Seattle, Washington 98115-0070

February 5, 1998

CRUISE RESULTS

Cruise 97-1 *Arcturus*
Cruise 97-1 *Aldebaran*

1997 Eastern Bering Sea Crab and Groundfish Survey

June-August 1997

The Resource Assessment and Conservation Engineering (RACE) Division of the Alaska Fisheries Science Center (AFSC) conducted the annual crab and groundfish bottom trawl survey of the eastern Bering Sea shelf from June to August 1997. This was a continuation of the annual series of eastern Bering Sea crab-groundfish assessment surveys which began in 1971.

OBJECTIVES

The primary objective of this survey was to continue the annual series of assessment surveys of crab and groundfish of the eastern Bering Sea to provide information for:

1. the North Pacific Fishery Management Council on the distribution, abundance, and biological condition of important groundfish and crab species;

2. the U.S. fishing industry on catch per unit effort and size composition, and

3. the support of ongoing studies on the biology, behavior, and dynamics of key ecosystem components.

Secondary objectives were to:

1. conduct additional sampling in areas of high king crab and Tanner crab abundance to reduce variability in population estimates;

2. evaluate bottom trawl performance and configuration with net mensuration equipment;

3. study the effects of artificial light on the escapement behavior of fish under the bottom trawl footrope;

4. collect data on capture and escapement of fish and crabs at the footroope of standard bottom sampling trawls;

5. collect size composition data and whole specimens of weathervane scallop (*Patinopecten curinus*) for distribution studies;

6. collect stomach samples for trophic interaction studies;

7. collect specimens of bigmouth sculpin (*Hemitripterus bolini*), egg masses, and sponge to describe bigmouth sculpin development and life history;

8. collect and preserve various whole specimens and tissue samples from both fish and invertebrates for special study requests;

9. record observations of pathological anomalies of various fish species to assess prevalence of infestations;

10. collect sculpin tissues samples for Swedish medical research investigations;

11. document whale observations made during the survey;

12. collect eulachon (*Thaleichthys pacificus*) for DNA studies conducted by the University of British Columbia;

13. collect fish specimens for the University of Victoria, British Columbia for museum skeletal collections;

14. collect specimens of *Gymnocanthus* for biological and ecological studies and;

15. collect fish specimens for fisheries scientists at the National Fisheries Research and Development Agency of the Republic of Korea for taxonomical studies.

VESSELS AND GEAR

Sampling at the standard sites was coordinated between two chartered commercial vessels, the F/V *Arcturus* and F/V *Aldebaran*. Both vessels were 39.6 m (130 ft) in length.

The bottom trawl used at all standard sampling stations was an 83-112 eastern trawl. These nets have a 25.3 m (83 ft) headrope and a 34.1 m (112 ft) footrope (Fig. 1). They were towed behind 1,000 kg, 1.8 X 2.7 m, steel V-doors and 54.9 m (180.1 ft) paired dandylines. Each lower dandyline had a 0.61 m chain extension connected to the lower wing edge to improve bottom tending characteristics. The 83-112 eastern trawl has been the standard sampling net used during annual eastern Bering Sea surveys since 1982 when it replaced the 400 mesh eastern trawl, previously used since the 1970s.

Seawater temperature profiles were collected at most sampling sites using a micro-bathythermograph attached to the headrope of the net. Surface seawater temperatures were also collected with a bucket thermometer lowered over the side of the vessels.

Net mensuration systems aboard both vessels were used to provide sampling net configuration and performance data to be used in area-swept and catch-per-unit-effort (CPUE) calculations.

Upon completion of the standard survey, the *Arcturus* conducted the footrope capture rate study with the 83-112 eastern trawl. The *Aldebaran* conducted a similar experiment using the standard Nor'eastern survey trawl, commonly used on Gulf of Alaska and Pacific west coast bottom trawl surveys. A secondary underbag net was attached to each of these individual nets at the wingtips and along the riblines as far back as the intermediate of the primary net. At the intermediate, the underbag split away from the primary and a complete secondary codend formed below the primary. The underbag had an independent footrope which attatched to the lower bridles. This underbag was designed to capture fish and crabs that may escape under the footrope of the primary net.

ITINERARY

The *Arcturus* and *Aldebaran* began the survey in Dutch Harbor, Alaska on June 4. The *Aldebaran* returned to Dutch Harbor on August 10 and the *Arcturus* returned to Dutch Harbor on August 6 upon the completion of the 1997 eastern Bering Sea crab-groundfish survey. Intervening port calls were made by both vessels in Akutan on June 19, Dutch Harbor on June 25,

and July 17 to obtain supplies and/or exchange scientific personnel.

SURVEY DESIGN AND METHODS

The standard survey area is shown in Figure 2. Sampling sites were established on the basis of a 20 x 20 nm grid pattern used during previous surveys, although more intensive sampling was carried out in the Pribilof Islands and St. Matthew Island regions to collect additional data on crab populations. Additional stations northwest of the standard survey area were established to estimate the abundance of Tanner crab (*Chionoecetes opilio*) in that area. Additional time was allocated to intensify sampling efforts near the standard station locations where large concentrations of king or Tanner crab were encountered.

The *Arcturus* and *Aldebaran* then sampled alternate north/south columns of stations proceeding from Bristol Bay westward to the shelf edge. Tows of 30 minutes in duration were made at most sampling sites. All catches were sorted to the lowest possible taxon, weighed, and enumerated. Station data including time, position, trawl performance, distance fished as well as catch information were entered onto diskettes with shipboard computer systems. Age samples (by sex-centimeter category), size composition, and other biological data were collected from the major fish species encountered. Length-width measurements, shell condition, clutch size, and tissues and organs for various studies were collected from the major crab species. Special study collections were stored in appropriate fixatives or were frozen.

RESULTS

The *Arcturus* and *Aldebaran* conducted a total of 382 bottom trawls during the survey including 376 successfully completed trawls at scheduled sampling sites and 6 unsuccessful hauls.

Upon completion of the standard survey, the *Arcturus* conducted an additional 31 hauls to evaluate the capture and escapement of fish and crabs at the footrope of the 83-112 bottom trawl.

The *Aldebaran* completed a total of 82 special study hauls including 28 tows to evaluate the effect of artificial light on fish escapement under the footrope of the Nor'eastern bottom trawl.

Biological data collected from fish species are summarized in Table 1. The two vessels recorded 146,845 length measurements from the major fish species and nearly 3,250 age structures were collected and preserved. Individual length-weight data were also recorded for yellowfin sole. A total of 8,617 stomachs were preserved from various fish taxa for food habit analysis.

Whole specimens and tissue samples of various fish and invertebrate species were preserved for identification, training, and other purposes.

The total standard survey area encompassed approximately 463,400 km^2. Catch rates of important fish and crab species, by depth zone, are shown in Table 2.

Walleye pollock (*Theragra chalcogramma*) was the most abundant fish species and had an overall CPUE of 74.3 kg/ha trawled. They were encountered at nearly all sampling sites, with largest mean catches (106.0 kg/ha) observed in central shelf waters at depths of 50-100 m (Fig. 3). Mean catches were much lower at depths less than 50 m (11.9 kg/ha).

Rock sole (*Pleuronectes bilineata*) and yellowfin sole (*Limanda aspera*) were the most abundant flatfish species, with overall CPUE values of 60.1 kg/ha and 46.2 kg/ha, respectively. Yellowfin sole were primarily restricted to the central and inner shelf waters, while rock sole were more broadly distributed with concentrations in Bristol Bay, around the Pribilof Islands, and the outer shelf (Figs. 4 and 5). Yellowfin sole catches decreased sharply with increased depth, from 115.3 kg/ha in waters less than 50 m to less than 0.1 kg/ha in waters greater than 100 m (Table 2). A similar depth-related decrease in rock sole abundance was also observed.

Pacific cod (*Gadus macrocephalus*) were encountered at nearly all sites sampled (Fig. 6). Catch rates were smallest at inner shelf stations less than 50 m.

Alaska plaice (*P. quadrituberculatus*), flathead sole/Bering flounder (*Hippoglossoides elassodon* and *H. robustus*), arrowtooth/Kamchatka flounder (*Atherestes stomias* and *A. evermanni*), and Pacific halibut (*Hippoglossus stenolepis*) had a combined catch rate of 43.0 kg/ha. Alaska plaice and flathead sole/Bering flounder were the most abundant species of this group, with an overall catch rate of 14.1 kg/ha and 16.6 kg/ha respectively.

Opilio Tanner crab (*Chionocetes opilio*) was the most abundant commercially important crab species encountered, with a total average catch rate of 10.2 kg/ha. Red king crab (*Paralithoides camtschatica*) had an overall mean CPUE of 1.7 kg/ha while blue king crab (*P. platypus*) and Bairdi Tanner crab (*C. bairdi*) each had overall catch rates less than 1.0 kg/ha trawled.

SCIENTIFIC PERSONNEL[a]

F/V *Arcturus*

Leg 1	Leg 2	Leg 3
D. Nichol[b]	B. Otto[bc]	D. Nichol[b]
G. Mundell	M. Wilkins	J. Hoff
J. Hoff	F. Shaw	J. Jurada-Molina
T. Buckley	C. Derrah	J. Heeren
K. Smith[c]	J. Kim[d]	K. Smith
B. Stevens[c]	L. Robinson[c]	R. MacIntosh[c]

F/V *Aldebaran*

Leg 1	Leg 2	Leg 3
T. Sample[b]	P. Cummiskey[bc]	K. Weinberg[b]
B. McConnaughey	G. Walters	G. Mundell
F. Morado	L. Mooney	B. Page
D. Smith	M. Yang	D. Benjamin
C. Armistead[c]	C. Johnston	E. Munk[c]
J. Hagga[c]	C. Armistead[c]	C. Case[e]

[a] Personnel from the AFSC, Seattle, unless otherwise noted
[b] Field Party Chief
[c] Personnel from the AFSC, Kodiak Laboratory
[d] Personnel from the National Fisheries Research and Development Agency (NFRDA), Republic of Korea.
[e] U.S. Coast Guard, Kodiak, Alaska

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Table 1.--Biological data collected during the 1997 eastern Bering Sea crab-groundfish survey.

Species	Length measurements	Age structures[1/2/]	Stomach samples
Walleye pollock	35,536	1,241	2,862
Pacific cod	9,322	737	2,258
Yellowfin sole	26,034	470	889
Rock sole	34,938	339	435
Flathead sole/ Bering flounder[3/]	19,703	301	528
Pacific halibut	1,179	--	294
Alaska plaice	10,143	82	358
Arrowtooth flounder/ Kamchatka flounder[4/]	7,891	--	402
Greenland turbot	298	79	54
Rex sole	341	--	--
Longhead dab	208	--	--
Starry flounder	335	--	--
Arctic cod	51	--	--
Pacific herring	32	--	--
Sculpin spp.	218	--	218
Pacific Ocean perch	204	--	--
Skate spp.	319	--	319
Misc. species	93	--	143
Total	146,845	3,249	8,617

[1/] Scale scrape samples, in addition to otoliths, were collected from Pacific cod. Only otoliths were taken from all other species.
[2/] Individual length-weight data were also collected from Alaska plaice and flathead sole.
[3/] Age structures were collected from flathead sole only.
[4/] Age structures were collected from each species separately.

Table 2.--Catch rates (kg/ha) by depth zone of commercially important fish and crab species taken aboard the *Arcturus* and *Aldebaran* during the 1997 eastern Bering Sea crab-groundfish survey.

Species	Inner shelf < 50 m	Central shelf 50-100 m	Outer shelf 100-200 m	Total area
Walleye pollock	11.9	106.0	75.0	74.3
Yellowfin sole	115.3	35.8	<0.1	46.2
Rock sole	134.2	50.4	8.0	60.1
Pacific cod	8.3	15.6	13.5	13.2
Alaska plaice	13.3	20.7	2.5	14.1
Flathead sole/ Bering flounder	3.3	15.4	31.3	16.6
Arrowtooth flounder/ Kamchatka flounder	<0.1	5.6	25.8	9.5
Pacific halibut	3.3	2.9	3.7	3.2
Opilio Tanner crab	0.1	14.8	11.4	10.2
Red king crab	1.7	2.8	0.0	1.7
Bairdi Tanner crab	0.1	0.6	0.4	0.4
Blue king crab	0.0	1.0	0.1	0.5

83/112 EASTERN

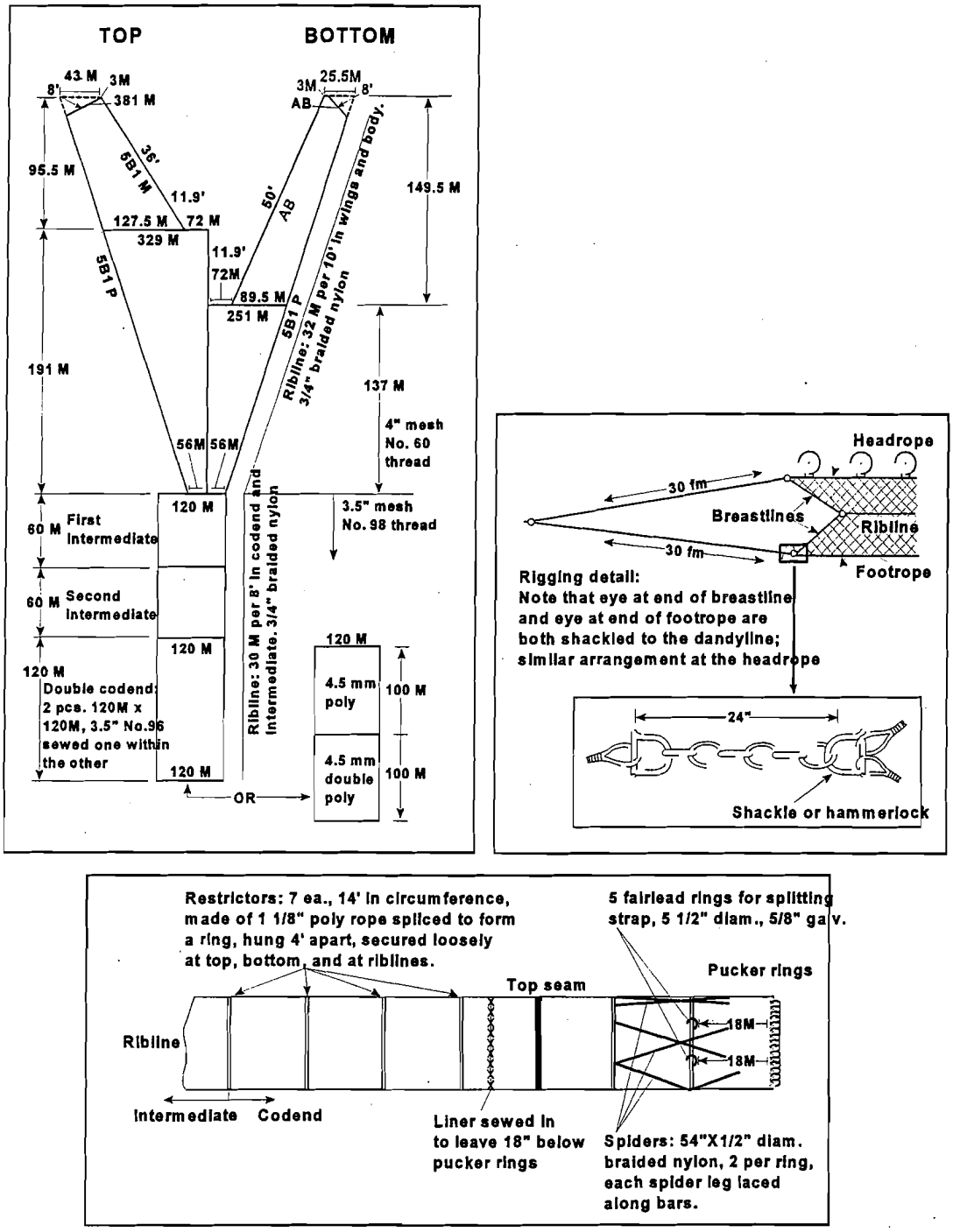

Figure 1.--Diagram of the 83-112 eastern bottom trawl used in the 1997 eastern Bering Sea groundfish survey.

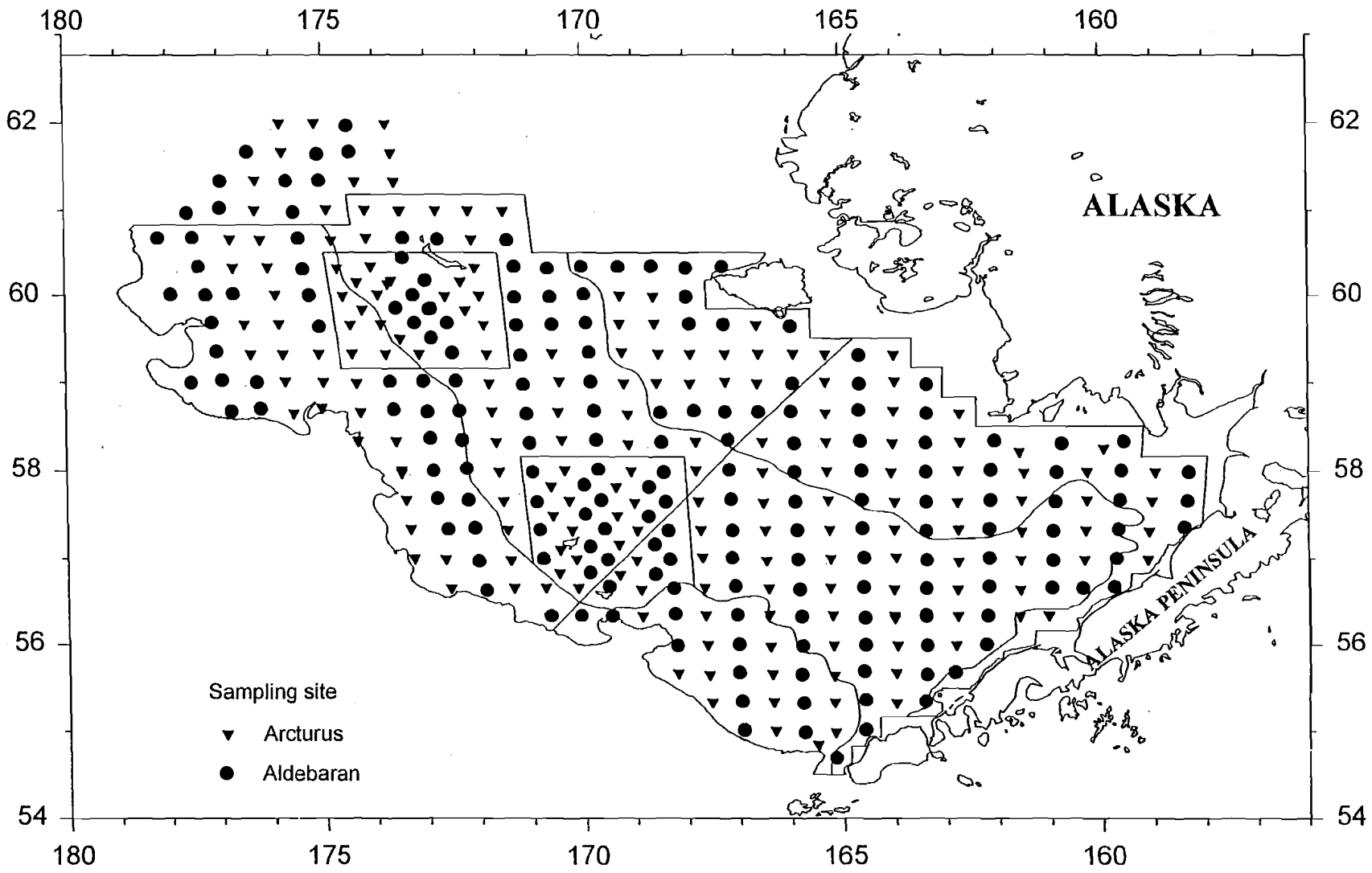

Figure 2.--Distribution of total sampling effort by the Arcturus and Aldebaran during the the 1997 eastern Bering Sea crab and groundfish survey.

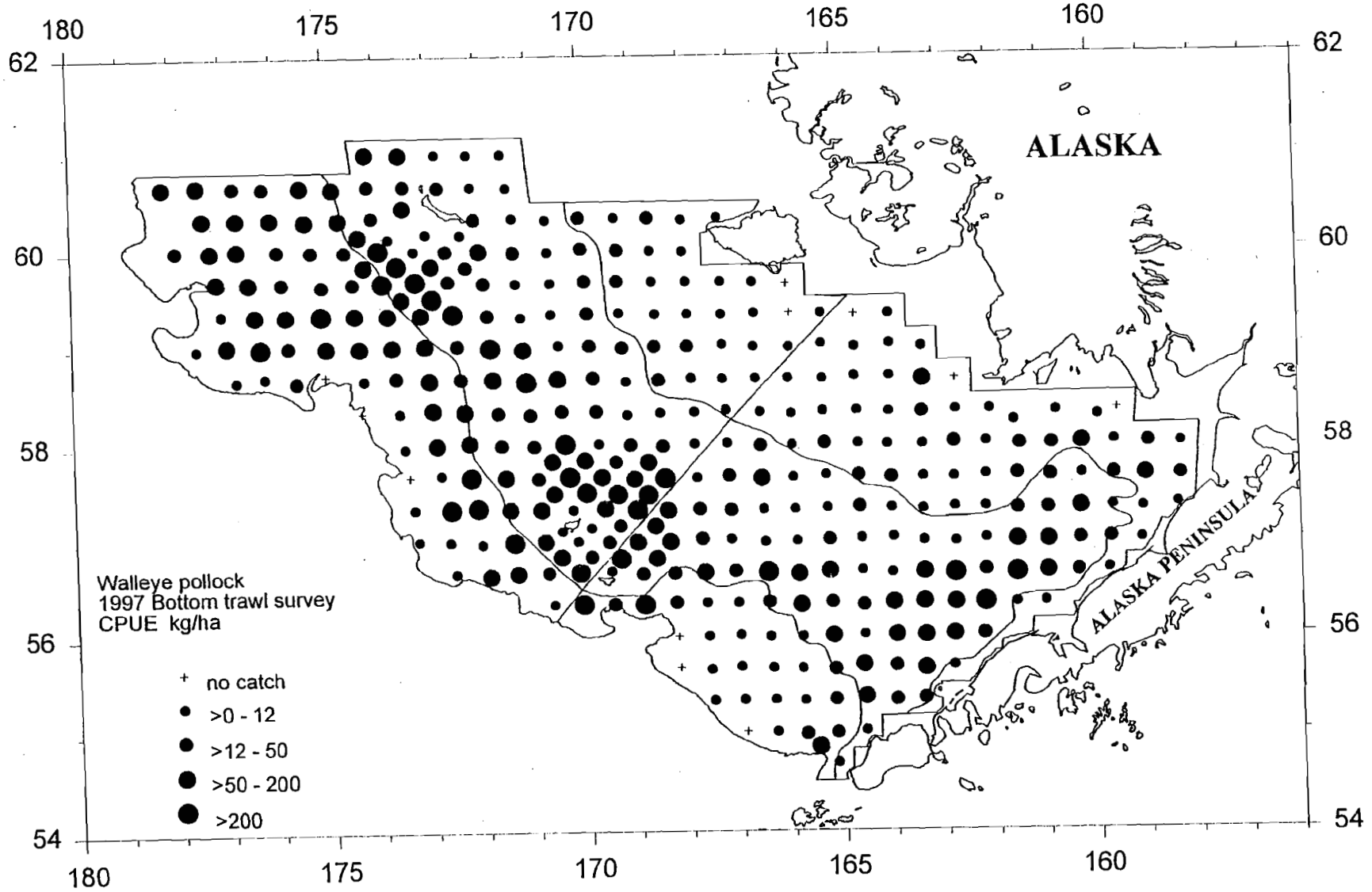

Figure 3.--Distribution and relative abundance of walleye pollock during the 1997 eastern Bering Sea bottom trawl survey.

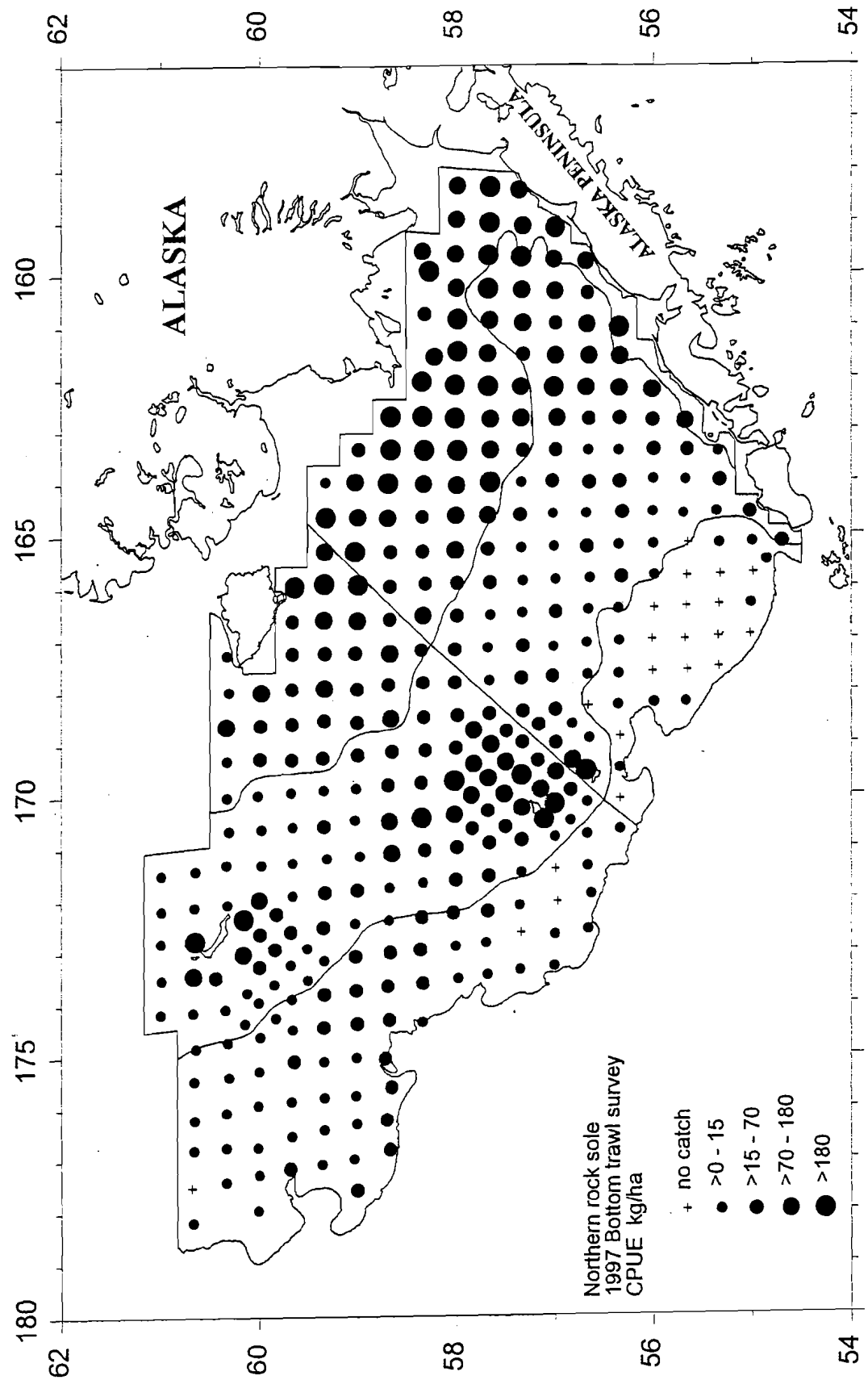

Figure 4.--Distribution and relative abundance of northern rock sole during the 1997 eastern Bering Sea bottom trawl survey.

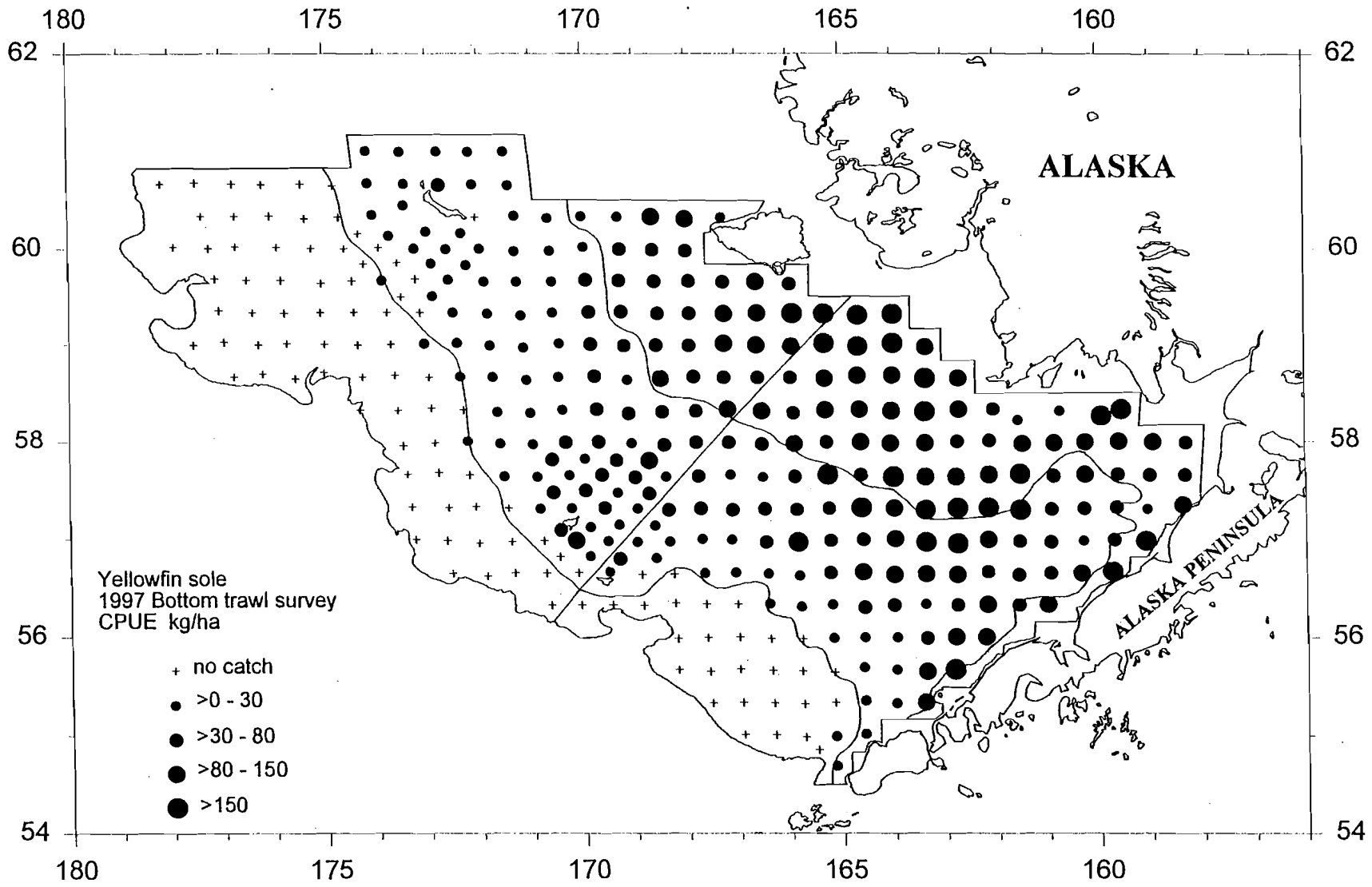

Figure 5.--Distribution and relative abundance of yellowfin sole during the 1997 eastern Bering Sea bottom trawl survey.